NASA SLI-Technology Studies

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Background

- 2014: NASA/USGS Architecture Study Team (AST) examined options for long-term mission architectures
  - Based on LST feedback, emphasized opportunities for smaller observatories
    - Smaller platform => lower cost => higher launch cadence & constellation formation => more frequent imaging
    - Enables SLI launch as secondary payload (cost reduction)
  - Other options included
    - Migration of SLI to hyperspectral capability
    - Reliance on international systems (e.g. Sentinel-2) for reflective multispectral continuity

- 2014-15: Reduced Instrument Envelope Size (RIES) Studies
  - Funded six companies to pursue small instrument concepts that could meet Landsat-8 requirements (+ 60m TIR)

- 2016: NASA Earth Science Technology Office (ESTO) ROSES Solicitation

SLI Reduced Envelope Study

- SLI funded six contracts to study options for reducing VSWIR/TIR instrument size
  - Goal of 50x50x50cm volume, 50W, 50kg, with L8 specs (and 60m TIR)
  - Contractors asked to explore design concepts, identify driving requirements, consider technologies that are likely to be available in the ***Landsat 10*** era
  - Disaggregation of TIR and VSWIR could be considered

- Awards made to:
  - Ball Aerospace & Technologies Corporation of Boulder, CO
  - Exelis Inc., Geospatial Systems of Fort Wayne, IN
  - Lockheed Martin Space Systems Company of Greenbelt, MD
  - Northrop Grumman Systems Corporation, Aerospace Systems of Redondo Beach, CA
  - Raytheon Company of El Segundo, CA
  - Surrey Satellite Technology US LLC of Englewood, CO

- 6-month studies complete March 2015 (with subsequent follow-on studies)

General REIS Findings

- The 50/50/50 target was not realistic, but many designs approached the volumetric goal (<1m^3 designs are feasible).
  - Both single- and multiple-instrument approaches
  - Small, fast optics
  - Smaller pitch detectors
  - Variety of scanning modes possible (pushbroom, push-whisk, step-stare…)
    - 15^o Field of view requirement limits telescope choices for a pushbroom; Whiskbroom scanners could use smaller FOV telescope designs
  - Compact fast telescope designs may be susceptible to stray light, and increased AOI variation on focal plane

- Edge Slope Response (~Point Spread Function) at longest wavelength (2.2 or 12 μm) drives aperture requirements and overall instrument size
  - Techniques exist to reduce the diffraction dictated apertures at the expense of data rate, SNR, and edge response ring.
    - FPA Oversampling
    - Detector geometries
    - MTF compensation in re-sampling algorithms (aka sharpening filters)

- Onboard calibration does not generally drive instrument size

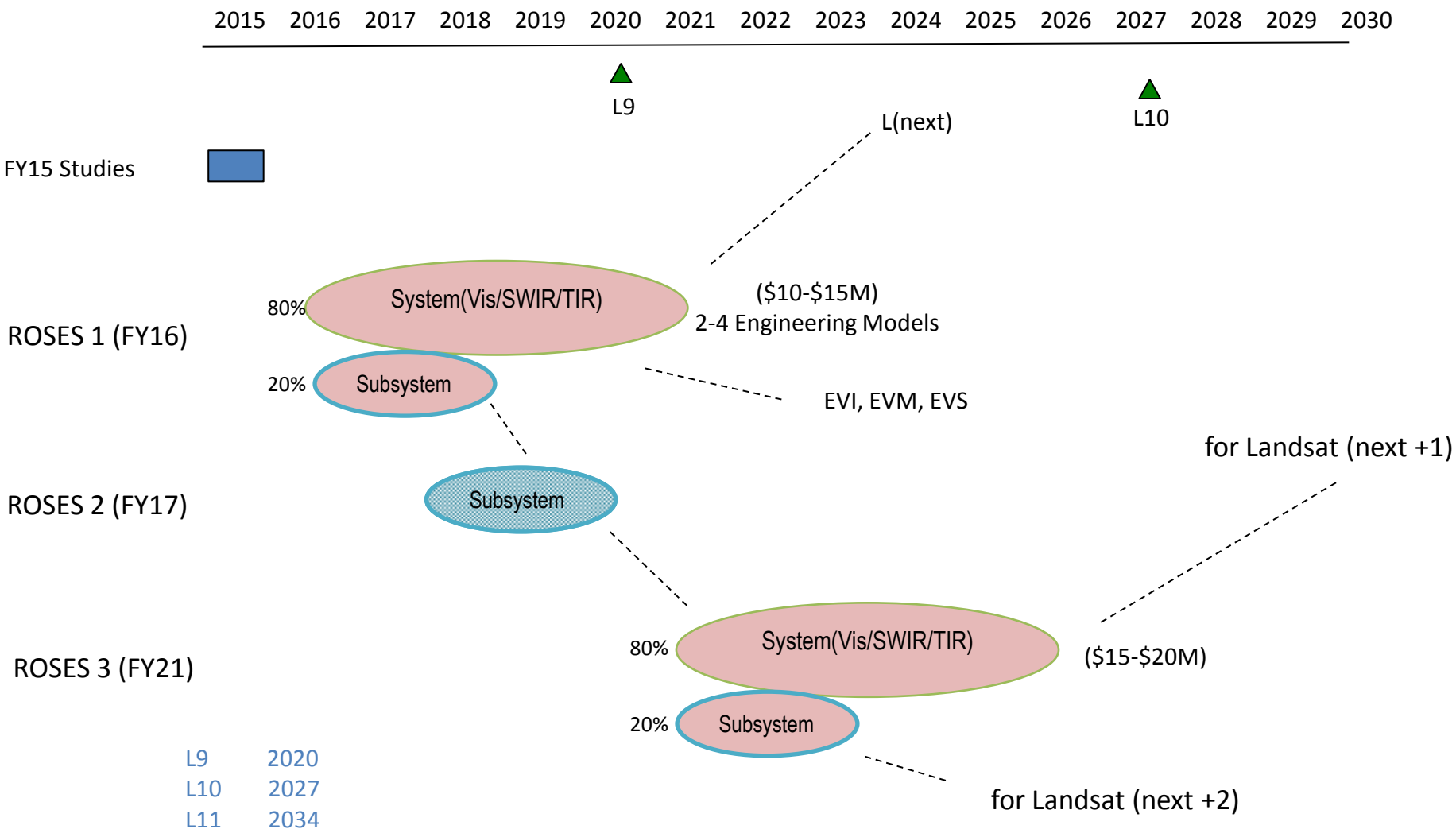
ESTO ROSES 2015 Solicitation

- Proposals to advance SLI goals through technology development
- Two types of proposals solicited
  - Advanced Technology Demonstrations
    - Instrument prototypes and demonstrations
    - 3-4 awards with up to $4.8M program budget (year 1)
    - 1-5 year awards
  - Technology Investments
    - Component or breadboard demonstrations of new technologies that could be infused in future land imaging instruments
    - 3-4 awards with up to $1.2M program budget (year 1)
- Reference Mission Architecture (based on Landsat-8) provided in solicitation
- Selections pending (likely August 2016)

General Technology Concepts

- Compact multispectral instruments
  - Pushbroom, Push-whisk, Step-stare
  - Wide FOV for better than 16-day coverage (e.g. ACMS)
- Hyperspectral systems
  - Grating (Ofner, Dyson)
  - Prism
- Near-term Components
  - Tactical cryocoolers
  - New detectors & arrays
  - Alternative calibration sources
- Advanced imaging technology
  - Optical interferometry
  - Waveguide optical systems

SLI-T Strategy FY16/17/21



Architecture Considerations

- Curtis: Have the technology studies to date eliminated any potential architecture or measurement concept for L10?
  - Not really. Very small cubesats (<=6U) probably not feasible, but other smallsat concepts are possible
  - Compact VSWIR and TIR imagers can be built that satisfy L8/L9 requirements
  - Compact hyperspectral imagers appear feasible with a few caveats
    - Stray light from grating systems difficult to predict
    - 10nm wavelengths may not "phase" with L8 30nm bandpasses
    - Required hyperspectral SNR may require aggregation to ~60m for compact system

- Key issues for future SLI mission architecture
  - What VSWIR enhancements are desired or required? What are their benefits relative to the existing capability? Can these be prioritized so that trades can be performed?
  - What is the appropriate role for Sentinel-2 in improving temporal frequency?
  - What frequency and resolution is required/desired for TIR observations?
  - Is there a community need/desire for hyperspectral data?